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PLAN FOR LOCATING WATER HARVESTING STRUCTURES IN UPPAR ODAI (SOUTH) USING RS AND GIS

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ABSTRACT

There is a need to establish water harvesting structures, to harvest the runoff water. The traditional method of the site selection process for different measures is a time consuming process however, but the identification of site with the use of GIS (Geographical Information System) makes the process become simple and reliable. The selection of sites for different measures must be based on certain criteria that take into consideration the physical characteristics of the study area. The study area Uppar odai (south) receives a sufficient amount of rainfall, but the entire quantity has been wasted due to lack of water conservation measure. It must be stored, in order to facilitate the users for irrigation and groundwater recharge. This study decided to use the weighted Overlay Index method in a GIS environment, to select the suitable sites, for establishing water harvesting structures.

KEYWORDS: Runoff, Recharge, Structure, Conservation & Stream Order

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Original Article

INTRODUCTION

Rainwater is the cleanest source of water, but its distribution is not uniform in all the area. India receives about 400 million hectare meters (m ha m) of rain per year over an area of 329 m ha. The rainfall ranges from as low as 100 mm in the Thar Desert, to 15,000 mm in the North east. (CPREEC, Tamil Nadu). The extreme events of flood and drought have recurring characteristics. If the runoff occurs enormous, could be redirected and stored, thus the water could be used in drought periods. Even rainfall as low as 100 mm, if harvested properly, can meet the domestic water requirement of the people.

Identification for water harvesting site selection has been based on local people's opinion and taking into consideration parameters such as land use map, Hydrology soil group map, slope map and DEM map (Singh and Litoria, 2008). Some of the aforesaid parameters have been defined by field study. Based on geological structure, land use and land cover (LULC), surface slope, and drainage order, water reservoirs have been classified as a storage tank, percolation tank, stop the tank and check dam and the sites determined (Buraihi and Shariff 2015, Prasad et al., 2014). Concern about widespread soil degradation and scarce, poorly managed water resources has led to the implementation of watershed management, investments throughout Asia, Africa and Latin America (Kerr and Chung, 2001). A reservoir is a proper sink that is located in the lowest altitude area of the catchment (Shabbir and Shakoor, 2013). In recent years, there is a demand to establish water harvesting projects in various places in Tamil Nadu to collect more runoff water and increasing the recharge time as well as to accommodate the drought period. The selection of the best sites for locating water harvesting structures must be based on certain criteria that take into consideration the physical characteristics of the targeted area. The aim of the study is to select

the optimum sites for water harvesting structures in the Uppar Odai (South) of Tamil Nadu.

STUDY AREA

The study area is Uppar Odai (South) watershed (4B2A7a2) of Amaravathy basin, situated in Dharapuram block, Thirupur district of Tamil Nadu. The study area of Uppar odai [Figure 1.], falls under the catchment area of the Amaravathi river basin. Geodetically, the study it is located 10^0 40' 30"N to 10^0 45' 30"N latitude and 77^0 15' 00"E to 77^0 30' 00"E longitude. The length of the area is about 18.5 km and encompasses the watershed area of about 79.5 km^2. The river Uppar Odai flows into north east direction. The highest point is at the height of 287 m and the lowest point is at the height of 179 m, from sea level.

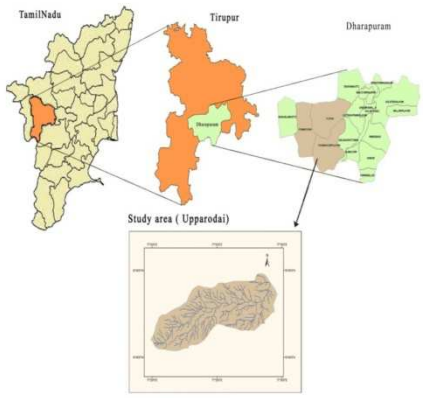
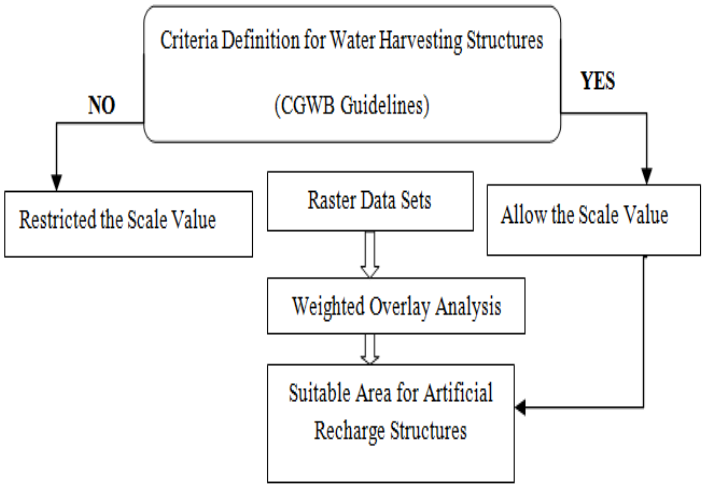


Figure 1: Location Map of Uppar Odai (South)

The monthly potential evapo-transpiration value varies from as low as 66 mm in November, to as high as 130.90 mm in May. The area is having slope in the range of 1- 25 percentages and depth of soil varies from 12 cm to 23 cm. The overflow and runoff could be checked, by constructing different harvesting structures that may vary with different parameters viz., rainfall, soil, slope, stream order and land use/cover. Hence, these parameters would be used for the construction of check dams, Grade bund, Percolation ponds and Farm ponds and are to be recommended at the appropriate location in Uppar Odai (South) watershed.

METHODOLOGY

The base map of the study area delineated using survey of India (SOI) topo sheet, with the help of satellite, showing watershed boundary, drainage pattern, water harvesting structure and land use pattern. The thematic maps of uppar odai (south) watershed were generated, for the analysis of rechargeable zone identification and locating the recharge structures like check dams, percolation ponds and farm ponds. The stepwise process has been carried out, to select the most suitable site for locating recharge structures [flow chart 1]. All the maps were generated and converted into raster maps, for further process. The next step was to overlay the maps, based on the required criteria for the particular recharge structure in the suitable area. After overlaying, the point for locating the recharge structures was manually done, by visual interpretation.



Flow chart 1: Methodology for Site Suitability Analysis

Rules for Site Selection of Rechargeable Structures

The following criteria have been followed for developing decision on suitable sites for various recharge structures as per Central Ground Water Board (CGWB) guidelines.

Check dams

Generally check dams are used to arrest the surface water flow and facilitate the recharge in short span of time. Check dams are constructed across streams, the flat and gentle slope of the terrain retains maximum quantity of water and feasible both in hard rock as well as alluvial formations. They are proposed where the stream is influenced or internally effluent. The site selection of check dam should have sufficient thickness of permeable bed or weathered formation to facilitate recharge of surface water. The criteria for the check dams has the slope should be 0-15 percent, Stream order I and II, type of soil should sandy clay loam and the downstream of check dam should be irrigable land.

Percolation Pond

Percolation pond construction only governed the percolation of the strata, not for the catchment yield. It is constructed by excavating a depression, forming a small reservoir in a natural ravine or gully to form an impounded type of reservoir. The criteria given for the percolation ponds are 3-5 percent slope, Stream order II and III, type of soil should be sandy loam and the land use may be non - cultivable one.

Farm Ponds

The Farm pond/ Dugout pond provides supplemental irrigation to the cultivable area during non-monsoon period. And should not locate in pervious soil, otherwise the water would be percolated. Suitable land and adequate soil should be available for forming embankments of the farm pond. The ideal location of the pond will be a narrow stream with high ground on either side of the stream (Singh et al., 2009). In the present study, the farm pond criteria were followed such as the slope should be 0 – 10 percent, Soil with clay content, land use may be Agricultural land or Non- Agricultural land and the infiltration rate of soil should be moderate.

Graded Bunds

It is a drainage type channel terrace or graded terrace, which is generally practiced in high rainfall areas or in the areas with impermeable soils. The location for graded bunds should undergo the criteria like slopes between 2 and 8 percent, the rainfall is greater than 700 mm or in less rainfall areas, land use may be agricultural land or non agricultural land and it is not suitable in clayey soil and suits only on non cracking soil.

RESULTS AND DISCUSSIONS

The spatial analyst tools were used to find the suitable locations and weighted overlay, table are allowed the calculation of the criteria analysis was taken between the required raster maps. Before going to do the overlaying process, scale value changes as restricted or not restricted. In the sense of this the input rater scale value to be found within the defined criteria, it implies that allows the value as such (not restricted) or else the remaining input raster scale value were assigned as restricted. The thematic map, designated in the scale value domain was prepared using restricted option (filtering technique) in the weighted overlay tool. After the weighted overlay process was carried out for selecting suitable sites to locate the water harvesting structures and which is presented through site suitability map. The check dam locating site was found in the eastern side of the study area [Figure 2.]. After the conduction of field investigation in the selected area, could recommend the exact position to construct the check dam to reduce the flow rate.

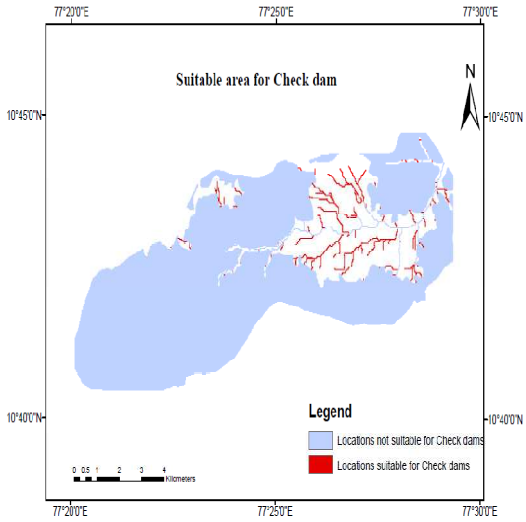


Figure 2: Location Map of Check Dam

The suitability of sites for percolation ponds was identified based on the soil having a high infiltration rate and satisfying other conditions as per the CGWB guidelines. The image [Figure.3] reveals that the three sites were found to be suitable for recommendation of percolation ponds in the study area. Since, it is located in second and third order drainage that saves percolation ponds from the damage due to high runoff. The percolation pond could be the best artificial recharge technique and it may raise the level of groundwater during the rainy season. The percolation pond vicinity area should have cultivable land and downstream of the tank in its command with a number of wells to ensure maximum benefit by such efforts. Adopt appropriate conservation measures to keep the tank free from siltation otherwise; it would reduce the percolation efficiency and life of the structure.

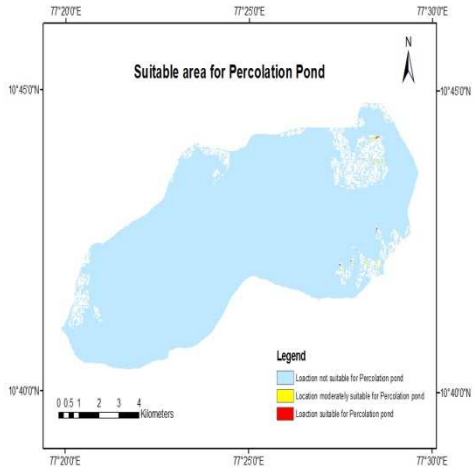


Figure 3: Location Map of Percolation Pond

Generally farm ponds provide with individual farms**.** The suitable sites for farm ponds were identified based on the soil texture with clayey content, free from any faults and the slope of 0-10%. The most part of the study area was found to be suitable sites for farm pond construction [Figure.4.]. According to the analysis four farm pond sites were recommended for stores the surface water which is used as the supplemental irrigation of second cropping.

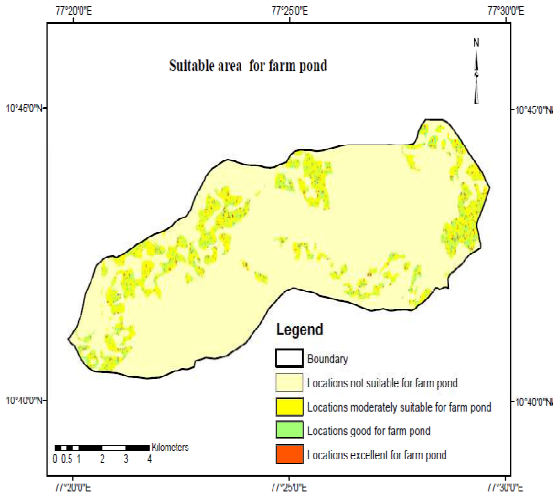


Figure 4: Location Map of Farm Pond

The suitable sites for graded burned and which has satisfied the suitable conditions of non-cracking soil and slope percentage (2-8%). The graded band suitable sites [Figure 5.] were mostly occurred in northeast portion and the remaining patches were occurred in the top portion of the area.

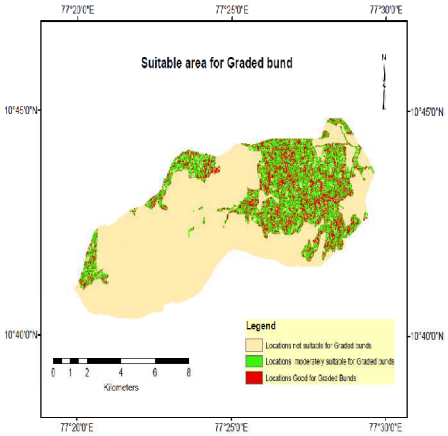


Figure 5: Location Map of Graded Bund

Buffer Map

The buffer map was prepared using the land use map with 200 meters from the existing structures vicinity. The map depicts a buffer zone helps to check the suitability sites for water harvesting structures. Thus the buffer zone analysis indicates all the locations of structures and the buffer area. The recommended construction should not overlap the buffer zone. This process confirms the suggested sites, are away from water spreading zones of the area for proper development of ground water augmentation.

Finally, 5 check dams, 3 Percolation ponds and 4 Farm ponds are recommended for harvesting the surface water [Figure 5.]. The suitability of other water harvesting structures could not be allocated because the area did not satisfy the suitability criteria.

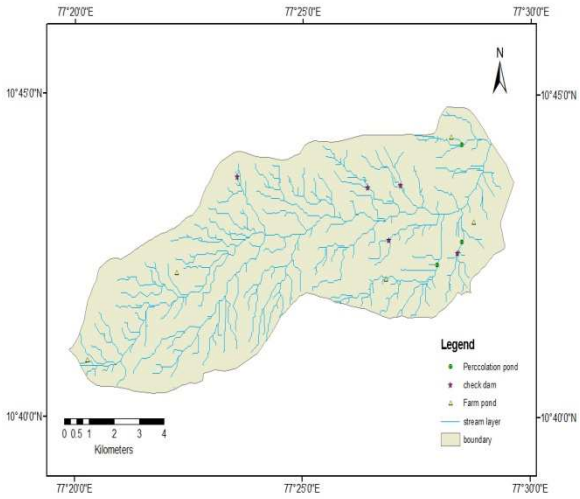


Figure 6: Location of Water Harvesting Structures in the Uppar Odai (South)

CONCLUSIONS

The resultant map was further crossed with the buffer map of existing structures, for identifying the suitable sites for water harvesting structures. Finally, plan for the location of recharge structures was prepared, for proper utilization of excess

runoff and ground water recharge. The gully section of the stream and the catchment area for the sites are to be verified, before the construction of the structures. Hence, the recommendation is to conduct the detailed survey, to verify the proposed sites and structures.

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